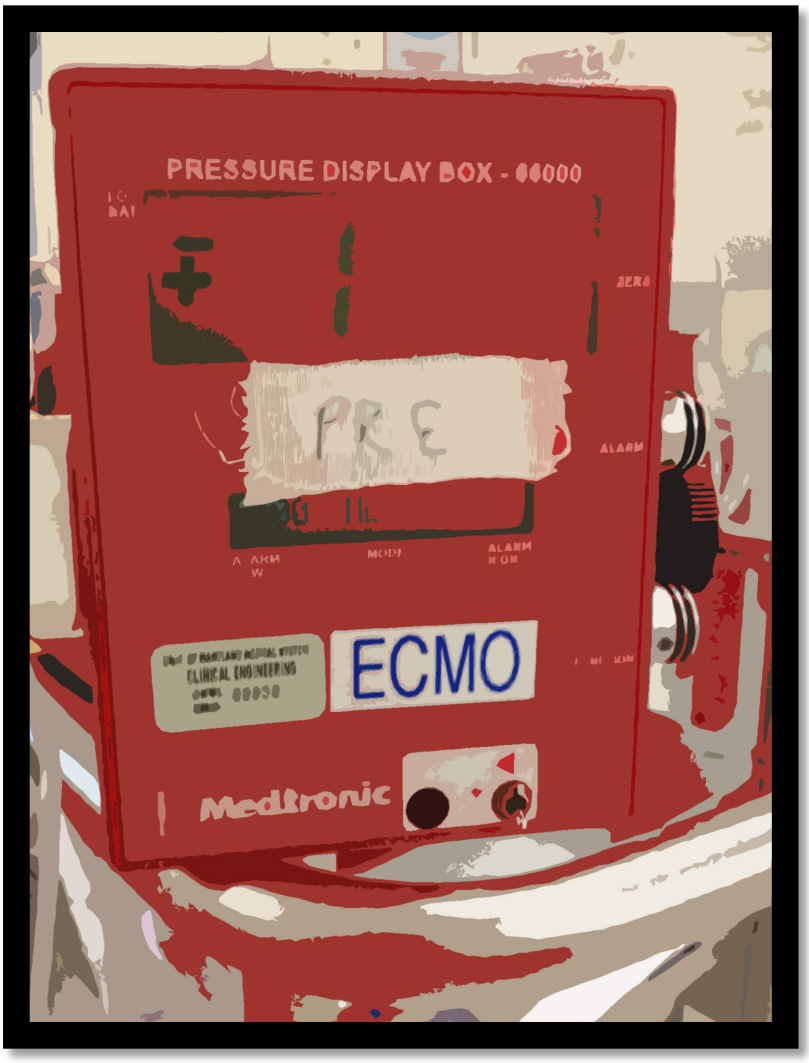
ECMO…. In the Emergency Department



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Objectives

At the end of this presentation, the participant will be able to:

- **Understand the differences between Venovenous (VV) and Venoarterial (VA) Extracorporeal membrane oxygenation (ECMO)**
- **Identify patients who may benefit from VA-ECMO for cardiogenic shock**
- **Set up an effective mechanism for ECMO initiation in the ED**

"Nobody deserves to die in the hospital without a trial of ECMO"
– Dr. Daniel Herr, MD

Out-of-hospital Cardiac Arrest Review

- Out-of-hospital cardiac arrest outcomes remain poor despite advancements in ACLS protocols and with conventional CPR (C-CPR)
  - ROSC < 40%
  - Survival to discharge 7-11 %[1]
  - Favorable neurological outcome 3-5%[2]
- Improved outcomes with
  - Therapeutic hypothermia post-ROSC [3,4]
  - Rapid defibrillation[5]
  - Cardiocerebral resuscitation [6,7,8]
  - Rapid PCI[9]
  - ECLS/ECMO Assisted CPR (E-CPR) (?)

ECMO Overview

- Venovenous ECMO (VV ECMO)
  - Primary goal: Support during reversible *respiratory* failure
  - Indications (ARDS, severe PNA, ILD, etc.) [10]
    - Refractory hypoxemia - P:F ratio< 80 for over 6 hrs
    - Refractory hypercapnia with acidemia – pH < 7.15 – 7.20
    - Excessively high P_{PLAT} >35-45 cm H_2O
  - Cannulation
    - Bicaval, dual-lumen Avelon™ catheter through the right internal jugular vein (23 or 27 French)
    - Dual insertion through the right IJ and femoral vein
- Venoarterial ECMO (VA ECMO)
  - Primary goal: Support during reversible *cardiac* failure/shock (CS)
    - Bridge to recovery, transplantation, destination therapy, *or decision*
  - Indications
    - Refractory cardiogenic shock[11,12]
      - Hypotension (SBP<80-90; MAP > 30mmHg from baseline)
      - End-organ dysfunction
      - Cardiac index < 1.8 - 2.2 L/min/m^2
      - PCWP > 18 mmHg
    - AHA: No specific hemodynamic recommendations[13]

        - ESC/EATS: No specific hemodynamic recommendations [12]
        - ELSO: No specific hemodynamic recommendations
    - Cannulation
        - Central cannulation to ascending aorta performed in the OR
        - Peripheral cannulation in femoral vessels performed at the bedside
            - Catheter size: 17 Fr arterial, 21 Fr venous
            - Arterial cannula rests in distal aorta
            - Provides retrograde flow
    - Improved physiology in cardiogenic shock
        - Decreased pulmonary artery pressure
        - Increased end organ perfusion
        - Increased PaO_2 over VV ECMO
    - ECMO flow rates [14]
        - Goal: Arterial pulse pressure $\geq$ 10 mmHg
        - Begin with 1.5 – 2L/min, titrate to 3-6L/min
        - May require vasopressor/inotropic support, goal MAP > 65
    - Additional considerations
        - Therapeutic hypothermia rapidly initiated through heat exchanger – Target core body temp: 32-34°C
        - Anticoagulation required
            - Unfractionated heparinization: body weight adjusted
        - Mechanical Ventilation
            - Lung protective ventilation (6-8cc/kg TV)
        - Monitor for distal limb ischemia

Extracorporeal Life Support assisted CPR (E-CPR)

- Indications
    - Down time is "brief"
    - Condition is reversible – coronary occlusion, drug induced, refractory arrhythmias
    - Condition is amenable to transplantation or revascularization
- In-hospital cardiac arrest
    - Chung et. al (2012): In-patients with acute CS treated with ECMO
        - Study: Prospective observational study of 134 patients
            - STEMI: 37 (27.6%)
            - Non-STEMI: 16 (11.9%)
        - Protocol initiated if C-CPR failed to ROSC after 30 minutes, contacted after 15 minutes
        - On pump within 25-30 min from cardiac arrest
        - **STEMI group outcomes significantly better**
    - Shin et. al (2011): In-patients with a cardiac cause of arrest
        - Improved survival to discharge
        - Improved 6-month survival with minimal neurologic impairment
        - When CPR > 30 min: E-CPR survival (19.2%) > C-CPR (1.3%)

- Out-of-hospital cardiac arrest
    - Inter-hospital variation in availability and protocol
    - Can be performed in the ED - Bellezzo et. al (2012)
        - Case series
            - Staged approach to ECLS initiation
            - 18 patients –8 patients transitioned to ECLS
        - Inclusion
            - Persistent arrest despite standard efforts
            - CS (SBP < 70 mmHg) refractory to medical treatment
        - Exclusion criteria
            - Asystole
            - Prolonged downtime without CPR (> 10 min)
            - Prolonged transport time (>10 min)
            - Prolonged arrest time (>10 min)
            - Suspicion of shock due to sepsis or hemorrhage
            - Pre-existing neurological disease prior to arrest
        - Outcomes
            - Survival to discharge, full neuro recovery: 5 (63%)
            - Non-survivors: mean ECLS time: 48.4 hrs
    - Kagawa et. al (2012)
        - Study: Retrospective review
        - Inclusion: Age 18 – 74, +/- Vfib, CPR initiated < 15 min from collapse, arrest, No ROSC within 20 min of C-CPR
            - 81 ACS patients
                - 61 received intra-arrest PCI
                - 20 did not receive PCI
        - Cardiac arrest followed by ECMO, PCI, and/or hypothermia
            - 30-day survival: 29%
            - Favorable neurologic outcome: 24%
        - Intra-arrest PCI, time interval from collapse to pump, and in hospital cardiac arrest were associated with 30-day survival
- What does this mean to you?
    - Skeptics (Lyon RM, 2012)
        - ECLS cost prohibits wide-spread adoption
        - Limited data for utilization of VA ECMO in cardiac arrest, and on which patients will benefit
    - Proponents
        - It is possible, data appears favorable for salvage therapy
        - Goal: Bridge to revascularization or further intervention
        - Algorithmic and team based result required
        - Good patient selection leads to improved outcomes

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